

Name: \_\_\_\_\_

Partner(s): \_\_\_\_\_

## AP Envi Sci – Temperature & Humidity

### Introduction:

Temperature is an important component of weather and climate because it greatly influences air pressure, wind, and the amount of moisture in the air. The unequal heating that takes place over the surface of the earth is what sets the atmosphere in motion, and the movement of air is what brings changes to our weather and causes surface waves in the ocean.

The single greatest cause for temperature variations over the surface of the earth is differences in the reception of solar radiation. The amount of solar energy (radiation) striking the earth is not constant throughout the year at any particular place, nor is it uniform over the face of the earth at any one time. However, the total amount of radiation that the earth intercepts from the sun equals the total radiation that it loses back to space. It is this balance between incoming and outgoing radiation that keeps the earth from becoming continuously hotter or colder. This lab examines how secondary factors such as the differential heating of land and water, ocean currents, and altitude can modify local temperatures.

**Specific heat** is the amount of heat per unit mass required to raise the temperature by one degree Celsius. The relationship between heat and temperature change is usually expressed in the form shown below where  $c$  is the specific heat.

$$Q = cm\Delta T$$

heat added                  specific heat      mass      change in temperature

The specific heat of water is 1 calorie/gram °C = 4.186 joule/gram °C. NOTE: The relationship does not apply if a phase change is encountered, because the heat added or removed during a phase change does not change the temperature.

### Part A: Land and Water Heating Experiment

OBJECTIVE: Investigate the differential heating of land and water by observing the equipment in the laboratory and conducting the following experiment by completing each of the indicated steps. Describe which material has a higher specific heat.

**Step 1.** Hang a light from a stand so it is about 5 inches above the top of the two beakers - one containing dry sand, the other water.

**Step 2.** Using a wood splint, suspend a thermometer in each beaker so that the bulbs are just below the surfaces of the sand and water.

**Step 3.** Record the starting temperatures for both the dry sand and water on the land and water heating data table, Table 1

**Step 4.** Turn on the light and record the temperatures on the data table at about 30-second intervals for 5 minutes.

**Step 5.** Turn off the light for several minutes. Dampen the sand with water and record the starting temperature of the damp sand on the data table. Turn on the light and record the temperature of the damp sand on the data table at about 30-second intervals for 5 minutes.

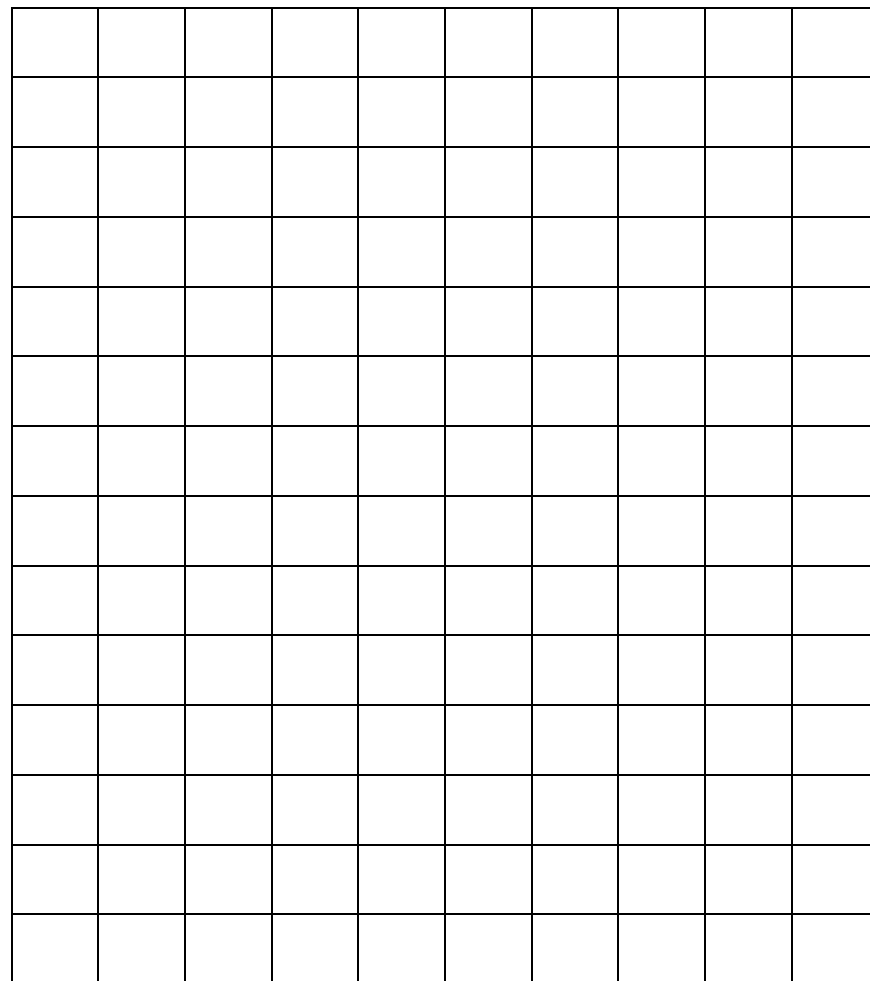
**Step 6.** Plot the temperatures for the water, dry sand, and damp sand from the data table to the graph, Figure 1. Use a different color line to connect the points for each material.

Table 1. Sand and water heating data table.

	Starting Temp.	0.5 min.	1.0 min.	1.5 min.	2.0 min.	2.5 min.	3.0 min.	3.5 min.	4.0 min.	4.5 min.	5.0 min.
Water											
Dry Sand											
Damp Sand											

Graph your results using 3 line graphs on the graph below:

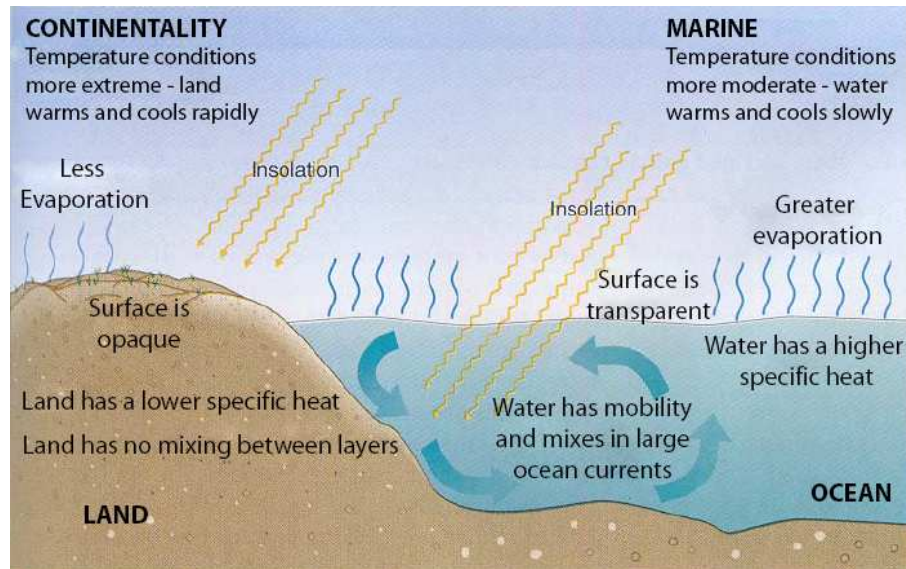
**Temperature (°C)**



**0                      1                      2                      3                      4                      5 Minutes**

1. How do the abilities to change temperature differ for dry sand and water when they are exposed to equal quantities of radiation?

2. How do the abilities to change temperature differ for dry sand and damp sand when they are exposed to equal quantities of radiation?



3. The figure above illustrates the idea of **continentality**. Make a connection between your lab results and larger bodies of land and water. Use “specific heat” in your explanation of the differential heating between land and water.

### Part B: Global Pattern of Temperature

The primary reason for global variations in surface temperatures is the unequal distribution of radiation over the earth. Among the most important secondary factors are differential heating of land and water, ocean currents, and differences in altitude.

Use Figures 2 and 3, Global Temperatures (°C) for January and July at the end of the handout to answer the questions below. The lines on the maps, called **isotherms**, connect places of equal surface temperature.

1. The general trend of the isotherms on the maps is (north-south, east-west). Circle your answer.
2. In general, how do surface temperatures on the earth vary from the equator toward the poles? Why does this variation occur?

3. The highest and lowest temperatures occur over which countries and oceans?

Highest global temperature\_\_\_\_\_

Lowest global temperature\_\_\_\_\_

4. The locations of the highest and lowest temperatures are over (land, water). Circle one

5. Calculate the annual temperature range at each of the following locations:

Coastal Norway around 60°N: Max\_\_\_\_\_°C , Min\_\_\_\_\_°C, Range\_\_\_\_\_°C

Siberia at 65°N, 130°E: Max\_\_\_\_\_°C , Min\_\_\_\_\_°C, Range\_\_\_\_\_°C

On the equator over the center of the Atlantic Ocean: Max\_\_\_\_\_°C , Min\_\_\_\_\_°C,  
Range\_\_\_\_\_°C

6. Why is the annual range of temperature in Siberia so large?

7. Why is the annual temperature range along the coast of Norway than at the same latitude as Siberia so low?

8. What do you notice about the temperature ranges in the tropics?

9. Use the two maps to calculate the approximate average annual temperature range for your location. How does your temperature range compare with those in the tropics and Siberia? SHOW ALL YOUR WORK!



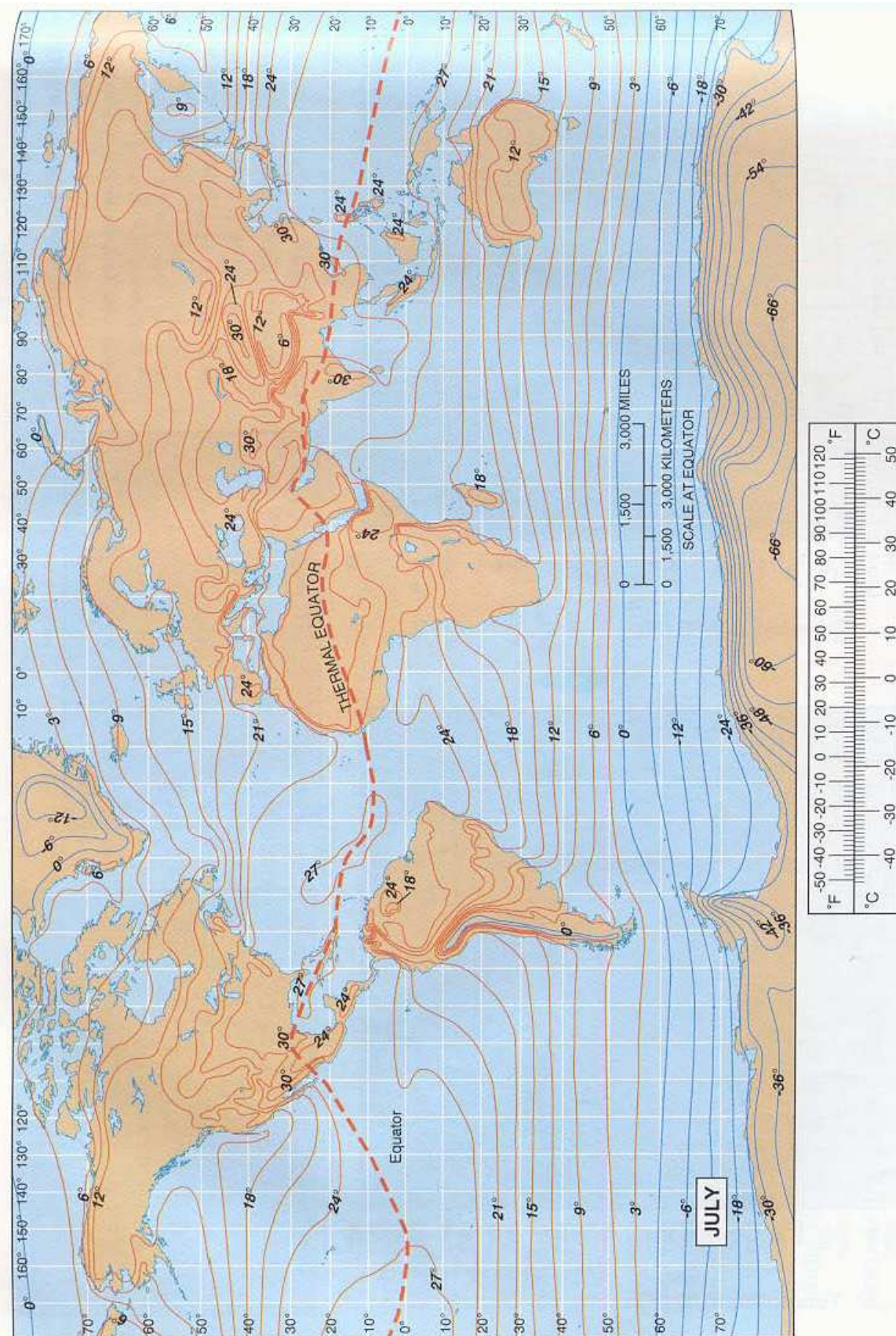


Fig. 2



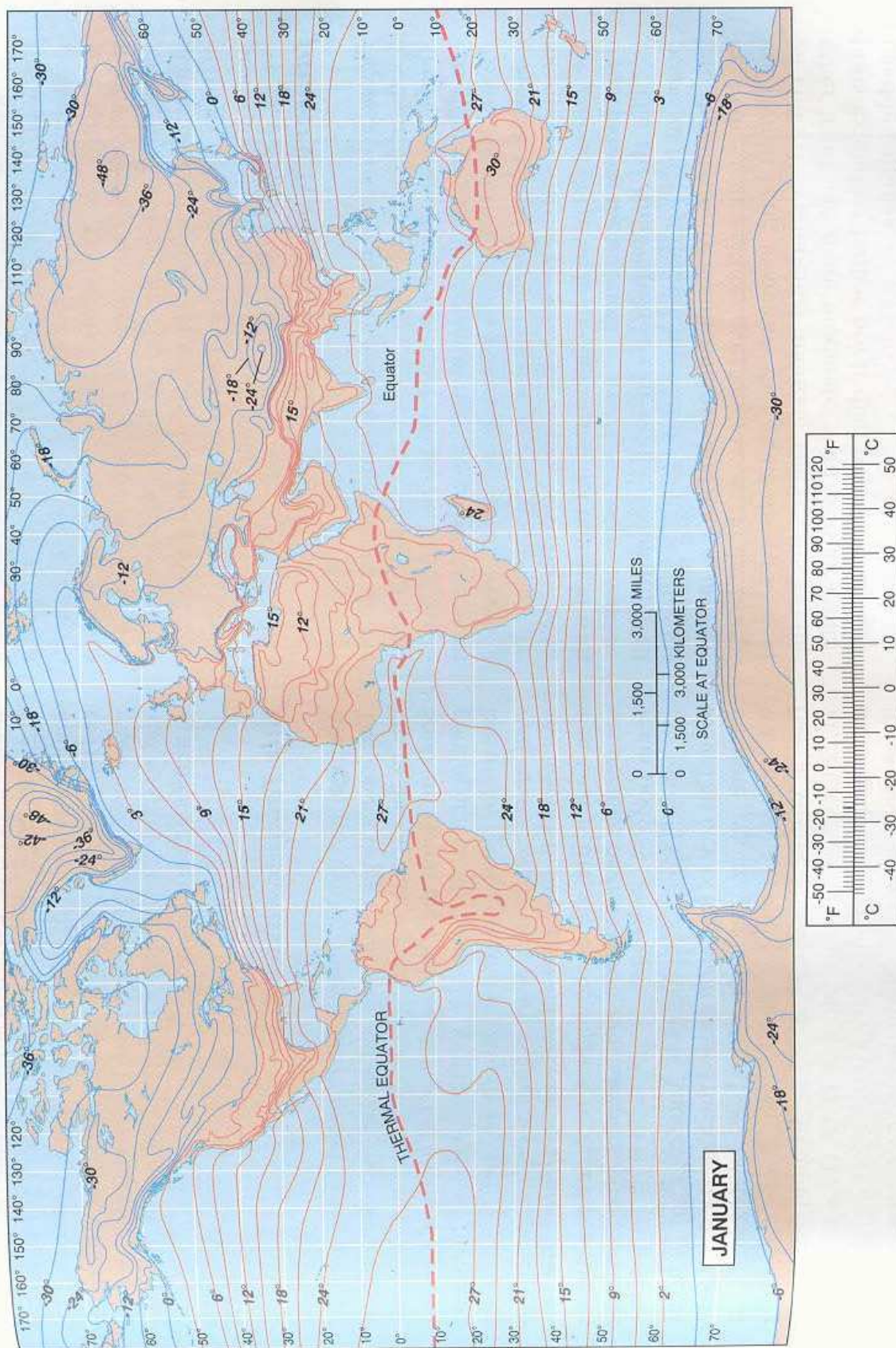


Fig. 3